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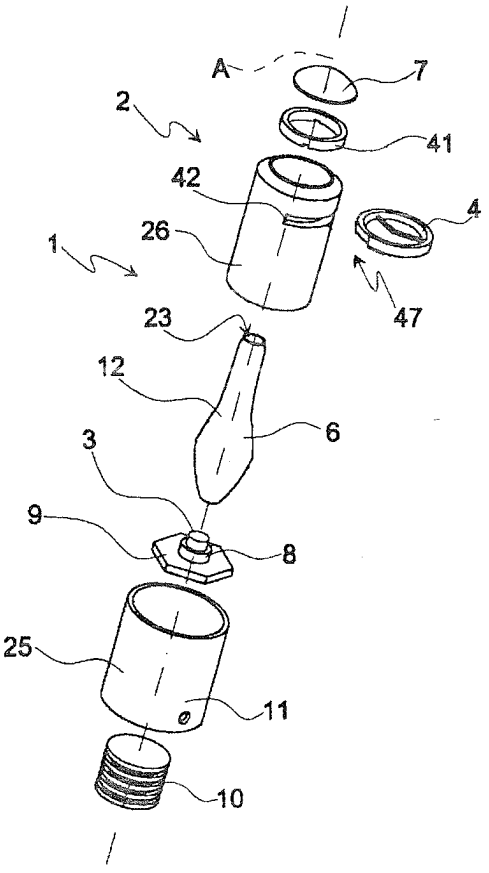
(54) **Title:** INTEGRATED PROJECTION UNIT IN PARTICULAR FOR PROJECTING IMAGES AND/OR LIGHT BEAMS OF PREDETERMINED GEOMETRY



(57) **Abstract:** An integrated projection unit (1), in particular for projecting images and/or light beams of predetermined geometry, has a casing (2) in which are housed a solid-state light source (3), in particular a light emitting diode (LED) ; a holder (4) for supporting, at a given distance from the source, at least one object whose image is to be projected; a first optical element (6) associated with the source (3) and for directing the light from the source (3) onto the holder (4) ; and a second optical element (7) carried by the casing (2) at a given distance from the holder (4). The first optical element (6) is a total internal reflection collector associated with the source (3) and interposed between the source (3) and the holder (4), and the second optical element (7) is a projection lens (or group of projection lenses).

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INTEGRATED PROJECTION UNIT, IN PARTICULAR FOR PROJECTING IMAGES AND/OR LIGHT BEAMS OF PREDETERMINED GEOMETRY

TECHNICAL FIELD

The present invention relates to an integrated projection unit which can be used in numerous types of systems for projecting images and/or light beams of given geometry, and in particular in image projection systems and lighting devices, for example, of vehicles (lights and headlights).

BACKGROUND ART

A projection device or system generally comprises a light source (lamp); and an optical assembly for directing the light beam from the source onto an object whose image is to be projected, and which may be fitted to a supporting member. In the case of lighting devices with light beams of predetermined geometry (e.g. vehicle headlights), the object whose image is to be projected is a screen or diaphragm which intercepts part of the light beam.

The devices or systems referred to above, whatever they are used for, are bulky, and comprise a fairly large

number of separate component parts involving a good deal of intricate, time-consuming assembly work. In particular, to ensure the optical elements are positioned correctly with respect to the object for projection, known devices call for accurate control of both the dimensions and position of the optical elements and object. It is also particularly important to ensure the object for projection is illuminated as brightly as possible, while avoiding light intensity dispersion : from which standpoint, most known devices are totally unsatisfactory. Moreover, in conventional systems, bright lighting is achieved using high-power (e.g. incandescent) lamps, which mean high energy consumption and heat dispersion, and relatively short working life.

DISCLOSURE OF INVENTION

It is therefore an object of the present invention to provide an integrated projection unit designed to eliminate the aforementioned drawbacks of the known state of the art, and which, in particular, provides for a high degree of efficiency, is cheap and easy to produce, can be installed easily in various devices (even of different types), is extremely compact, and has a high emitted luminous flux to power dissipation ratio.

According to the present invention, there is provided an integrated projection unit as claimed in attached Claim 1 and, as regards its auxiliary characteristics, in the dependent Claims.

The unit according to the invention is extremely

efficient and compact; is cheap and easy to produce; can be installed easily in various types of devices, and in particular in image projection and automotive lighting devices, with practically no major alterations required; ensures correct positioning of the optical element with respect to the object for projection; and provides for brightly illuminating the object for projection, with practically no light intensity dispersion.

BRIEF DESCRIPTION OF THE DRAWINGS

A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic exploded view in perspective of an integrated projection unit in accordance with the invention;

Figure 2 shows a schematic longitudinal section of the Figure 1 unit as assembled;

Figure 3 shows a longitudinal section of a first component of the Figure 1 unit;

Figures 4 to 6 show a bottom plan view, section, and top plan view respectively of a second component of the Figure 1 unit;

Figures 7 and 8 show, schematically, preferred applications of the Figure 1 unit.

BEST MODE FOR CARRYING OUT THE INVENTION

Number 1 in Figures 1 and 2 indicates an integrated projection unit, in particular for use as a vehicle lower-beam headlight. Unit 1 comprises a, for example,

substantially cylindrical casing 2, in which are housed a solid-state light source 3, in particular a light emitting diode (LED); a holder 4 for supporting, at a given distance from source 3, at least one object whose image is to be projected; a first optical element 6 associated with source 3 to direct the light from source 3 onto holder 4; and a second optical element 7 carried by casing 2 at a given distance from holder 4.

In accordance with a known solution, source 3 is fitted to a mount 8 having a heat dissipating plate 9. For the sake of simplicity, the known contacts and connections connecting source 3 electrically to an external network are not shown; and plate 9 is in turn connected to a further (known) heat dissipator 10 projecting axially out of and from a longitudinal end 11 of casing 2.

Optical element 6 is a high-efficiency total internal reflection collector, and comprises a body 12 made of transparent material and shaped to internally reflect and transmit the light emitted by source 3. In the example shown, body 12 is a body of revolution of rotational symmetry, has a central axis A of symmetry defining an optical axis of optical element 6, and, as of an axial end 13 facing source 3, comprises a convex portion 14 with a convex lateral surface; a tapered, longitudinally elongated portion 15 connected to portion 14 at a maximum-diameter section 16 and defining a locating portion 17; and a substantially cylindrical end

portion 18 at an axial end 19, opposite axial end 13, of body 12.

At axial end 13, body 12 has a recess 20 formed in portion 14 and in which source 3 is inserted. Recess 20 is defined by a collar 21 radially surrounding source 3 and terminating with an end edge fitted to mount 8, and has an inner surface 22 facing source 3 and defining a light inlet surface into optical element 6.

Portion 18 has a substantially flat end surface 23 defining a light outlet surface from optical element 6 and a lighting surface for lighting holder 4 and, more specifically, the object whose image is to be projected.

The geometry of optical element 6 is calculated to achieve maximum transfer of radiant flux from source 3 to lighting surface 23.

In a variation not shown, body 12, which is solid in Figure 2, may be hollow, with an inner cavity along axis A; in which case, end surface 23 is annular.

Casing 2 comprises two mutually cooperating members 25, 26, and coupling means 27 for fixing members 25, 26 integral with each other. More specifically, member 25 comprises a tubular, e.g. substantially cylindrical, body having an inner cavity 28 housing source 3 and relative mount 8; mount 8 is fixed to an end flange 29 of member 25 in known manner not described or shown for the sake of simplicity; and member 26 comprises a tubular, substantially cylindrical body having an end portion 32, which slides axially inside cavity 28 of member 25 and is

secured to member 25 by coupling means 27 defined, for example, by a threaded coupling (shown only schematically in Figure 2) or other known type of coupling.

Member 26 has an inner cavity 33, and comprises a seating portion 34 defined, in the example shown, by a truncated-cone-shaped lead-in located at the inlet of cavity 33 and which cooperates axially with locating portion 17 of optical element 6 to grip optical element 6 against mount 8 when members 25, 26 are connected. In the example shown, member 26 and optical element 6 cooperate at respective sloping or truncated-cone-shaped annular surfaces 36, 37 of seating portion 34 and locating portion 17 respectively, so that optical element 6 is gripped by casing 2 against mount 8 and rests axially on mount 8.

As shown also in Figure 3, cavity 33 has a substantially cylindrical, narrow-section, intermediate centering portion 38 in which portion 18 of optical element 6 is inserted; at an end 39 of casing 2, longitudinally opposite end 11 at which source 3 is located, cavity 33 terminates with a seat 40 for second optical element 7 which, in the example shown, is a projection lens (or a number of lenses); and lens 7 may be fixed directly to seat 40 (as in Figure 2) in any known manner, or be carried by a collar 41 (Figure 1) fixed in known manner to seat 40. In a preferred alternative embodiment, lens 7 is molded directly in one piece with casing 2.

Member 26 has a seat 42 for removable insertion of holder 4, and which is defined, for example, by a radial opening formed radially through the lateral wall of member 26 and having a given circumferential extension.

Holder 4 comprises a substantially circular screen 43 shown in detail in Figures 4 to 6. Screen 43 comprises an annular rim 44 having a peripheral edge 45 which fits to seat 42; and a contoured diaphragm 46 constituting the object whose image is to be projected, and defining, in the example shown, the shape of the light beam from unit 1. In the purely non-limiting example shown, diaphragm 46 is shaped to form a light beam of known geometry as prescribed for lower-beam lighting of a vehicle.

Screen 43 is inserted radially (and therefore perpendicularly to axis A and parallel to lighting surface 23) inside seat 42; and locking means of any known type, e.g. force-fit or bayonet connecting means (indicated as a whole by 47), may be provided for securing screen 43 to casing 2.

Once inserted inside seat 42, screen 43 is fitted to casing 2 facing lighting surface 23 and a given distance from source 3, so that optical element 6 is interposed axially between source 3 and holder 4, and holder 4 is interposed axially between optical elements 6 and 7.

Unit 1 may thus be used as a vehicle lower-beam headlight; and units of the same type with different screens may be used in automotive lighting systems for other functions (upper-beam headlights, foglights, etc.,

depending on the shape of diaphragm 46).

To increase the light intensity and/or vary the geometry of the light beam emitted by one unit 1, a number of units 1 may be used in a given spatial arrangement (and the shape of screen 43 of each unit 1 possibly adapted accordingly).

Another application of unit 1 is shown schematically in Figure 7, in which unit 1 is installed in a signaling device 50 having a casing 51 housing unit 1 and which may be either portable or fixable to a supporting surface by known fastening members; and holder 4 comprises a screen 43 with a mask 53 defining the image for projection.

Images of any type, comprising alphanumeric characters, drawings, graphic symbols, etc., may obviously be projected; and signaling device 50 may be used for projecting emergency signs (direction messages or signs for safety exits or emergency routes), or for producing graphic and/or lighting effects for advertising or entertainment purposes, etc.

Another preferred application of unit 1 is shown in Figure 8, in which unit 1 is installed in the casing 54 of a projector 55, e.g. for slides (or similar); in which case, the object whose image is to be projected is a slide carried by an appropriate holder 4. Provision may be made for a number of interchangeable holders 4 housed in a loader 56 (e.g. a carousel type) for selectively feeding holders 4 into seat 42 to selectively change the projected image.

Clearly, changes may be made to the unit as described and illustrated herein without, however, departing from the scope of the present invention.

For example, in one possible variation, the object whose image is to be projected is placed directly on lighting surface 23, which thus defines holder 4.

CLAIMS

1) An integrated projection unit (1), in particular for projecting images and/or light beams of predetermined geometry, comprising a light source (3) fitted to a mount (8); a holder (4) for supporting, at a given distance from the source, at least one object whose image is to be projected; and a first optical element (6) for directing the light from the source onto the holder; the unit being characterized in that said source (3) is a solid-state source, in particular a LED; and said first optical element (6) is a total internal reflection collector associated with the source (3) and interposed between the source (3) and the holder (4).

2) A unit as claimed in Claim 1, characterized by comprising a casing (2) housing said first optical element (6); the holder (4) being carried by said casing (2) at a predetermined distance from the source (3); and said first optical element (6) being interposed between the source and the holder.

3) A unit as claimed in Claim 1 or 2, characterized in that said first optical element (6) has a lighting surface (23) facing the holder (4).

4) A unit as claimed in Claim 3, characterized in that said first optical element (6) comprises a body (12) made of transparent material and shaped to internally transmit the light from the source (3) onto said holder (4); said body (12) having a light inlet surface (22)

facing the source, and an outlet surface (23) defining said lighting surface.

5) A unit as claimed in Claim 3 or 4, characterized in that said lighting surface (23) supports the object whose image is to be projected, and defines said holder (4).

6) A unit as claimed in Claim 3 or 4, characterized in that the holder (4) comprises a screen (43) carried by said casing (2) and facing said lighting surface (23).

7) A unit as claimed in Claim 6, characterized in that said casing (2) has a seat (42) for removable insertion of the screen (43); the screen being inserted inside the seat in a direction substantially perpendicular to an optical axis (A) of said first optical element (6) and parallel to said lighting surface (23).

8) A unit as claimed in Claim 7, characterized by comprising locking means (47) for locking said screen (43) to the casing (2).

9) A unit as claimed in one of Claims 3 to 8, characterized in that the source (3), the mount (8), the holder (4), and the first optical element (6) are housed in said casing (2); said first optical element (6) being gripped by the casing against the mount.

10) A unit as claimed in Claim 9, characterized in that the casing (2) comprises a first (26) and a second (25) member cooperating with each other; coupling means (27) being provided between the first and second member

to fix the two members integrally to each other.

11) A unit as claimed in Claim 10, characterized in that said first member (26) comprises a seating portion (34) cooperating axially with a locating portion (17) of the first optical element (6) to grip said first optical element against the mount (8).

12) A unit as claimed in Claim 11, characterized in that said first member (26) and said first optical element (6) cooperate at respective sloping or truncated-cone-shaped annular surfaces (36, 37).

13) A unit as claimed in one of Claims 3 to 12, characterized by comprising a second optical element (7) carried by said casing (2) at a given distance from the holder (4); the holder being interposed between the first optical element (6) and the second optical element (7).

14) A unit as claimed in Claim 13, characterized in that the second optical element (7) comprises one or more lenses fixed to a first end (39) of the casing (2); said source (3) being located at a second end (11) of the casing (2) longitudinally opposite said first end (39).

15) A unit as claimed in Claim 13 or 14, characterized in that the second optical element (7) is molded directly in one piece with said casing (2).

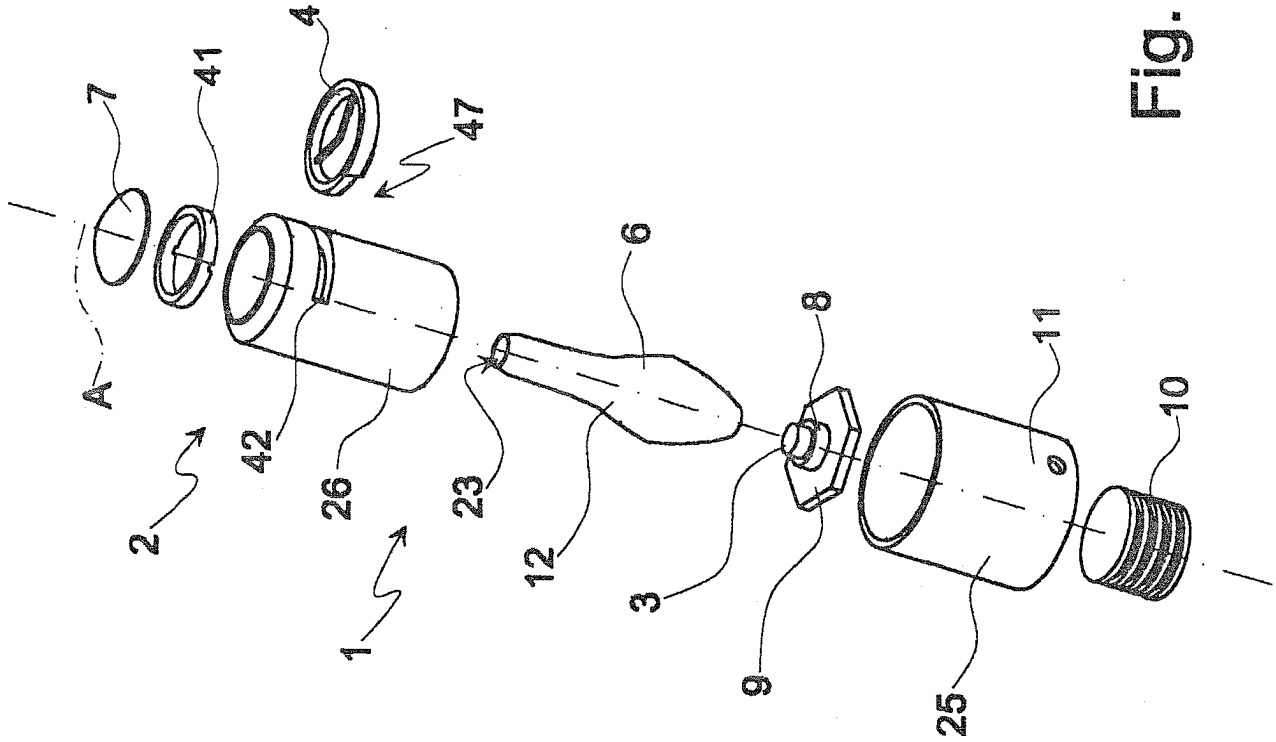
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Fig.1

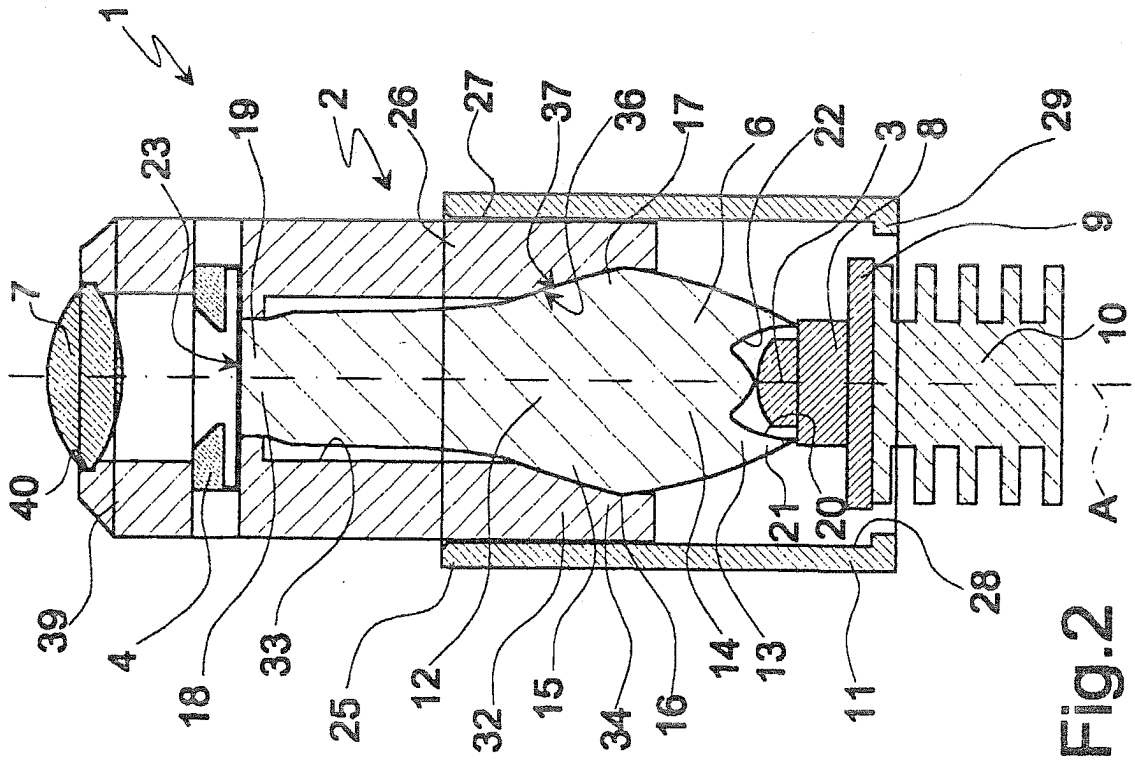
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Fig.2

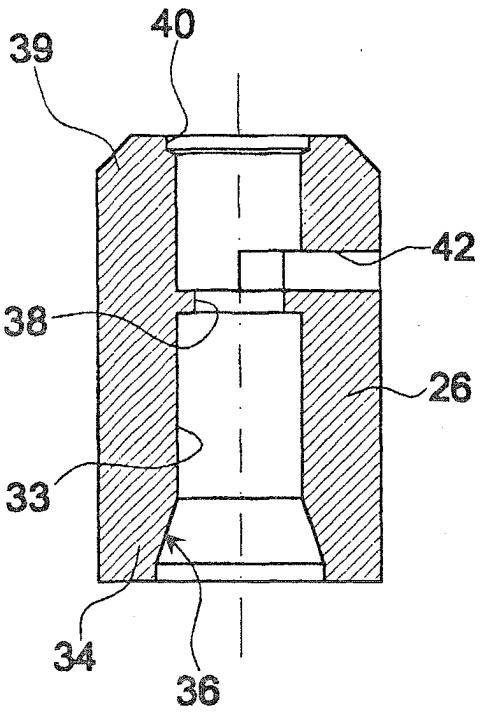


Fig.3

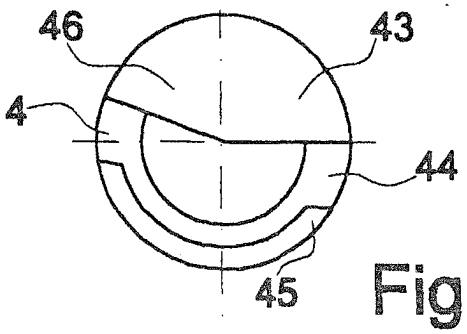


Fig.4

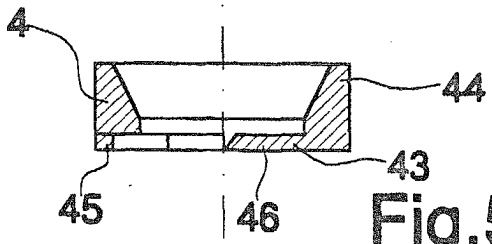


Fig.5

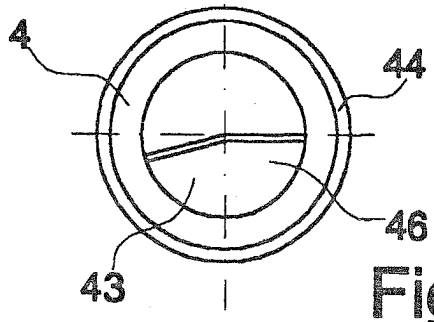


Fig.6

Fig.7

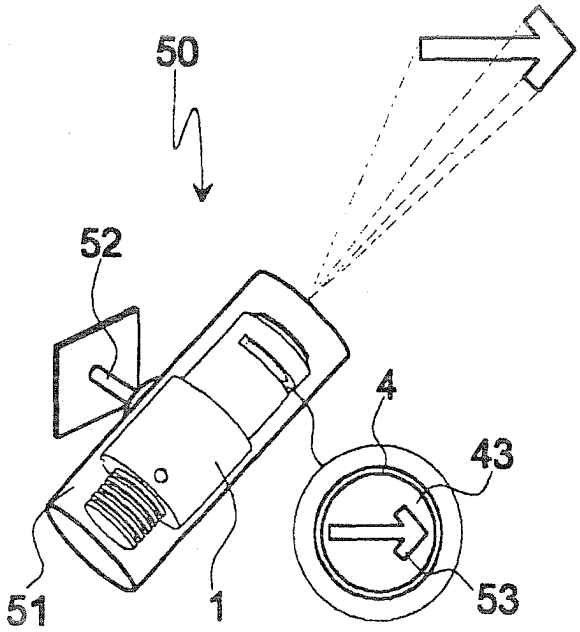
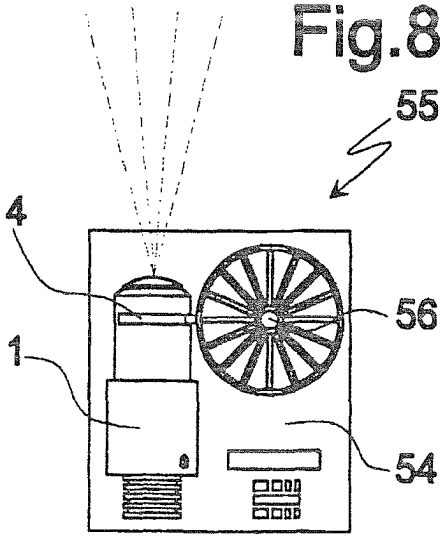


Fig.8



A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G03B21/26 G02B27/20 B60Q1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G03B G02B B60Q F21S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 297 15 156 U (F.U.FISCHER) 12 February 1998 (1998-02-12) page 1 -page 2; figures 1,2	1
A	DE 298 01 198 U (H.WALDMANN GMBH.) 14 May 1998 (1998-05-14) page 1 -page 3; figure 1	1
A	FR 2 121 375 A (Y.JOBIN) 25 August 1972 (1972-08-25) page 1 -page 2; figures 1,2	1
A	EP 1 167 874 A (HELLA KG HUECK & CO) 2 January 2002 (2002-01-02) column 3 -column 5; figures 1-5	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 June 2003	30/06/2003

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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